Submarine Emergency Evacuation System

Field of the Invention

The invention relates generally to evacuation systems for offshore fixed structures or vessels, and more particularly to submarine evacuation systems.

Background of the Invention

Current approved emergency evacuation systems for the international offshore are categorized as dry, semi-wet, and wet systems. Dry systems, such as helicopters, are the preferred alternative since personnel do not come into contact with the ocean environment. Nevertheless, such systems have limitations as unfavourable atmospheric conditions such as wind, fog, rain, freezing rain, icing or snow often preclude air-borne rescue. Unfortunately, these conditions are normally present when offshore installations are at peril.

Semi-wet systems, such as Totally Enclosed Motor Propelled Survival Craft (TEMPSC) and life rafts, are required on all offshore structures and do not always do what is expected of them. Though essential, these systems also have limitations. A TEMPSC launch from a rig can be perilous in severe weather conditions, and huge waves are often a mortal threat to these crafts.

Wet systems, such as lifejackets and immersion suits, act as a backup to dry and semi-wet systems. They are the Escape, Evacuation and Rescue (EER) of last resort and are used only if personnel are forced into the ocean. All EER systems in use today share a common element in that the final evacuation must be carried out by either air or surface craft. In most emergency evacuations, atmospheric or water surface conditions are extreme posing severe threat to human life.

Therefore, there is a need for an evacuation system capable of operating in various types of emergency situations, under extreme environmental conditions.

Summary of the Invention

The invention is directed to an evacuation system for an offshore unit. The evacuation system comprises at least one submarine evacuation module attached to the offshore unit.

In accordance with a specific aspect of this invention, a submarine evacuation module comprises a submarine for transporting personnel to be evacuated and a watertight submarine bay fixed to the offshore unit for holding the submarine; the bay has a door at one end or both ends to permit the launch of the submarine from the bay. The evacuation system may further include a shaft connecting the submarine bay to a predetermined location on the offshore unit to provide the personnel access to the submarine bay.

In accordance with a further aspect of the invention, the submarine evacuation module is attached to the offshore unit below the water level; the evacuation module may be located within or above a pontoon of a semi-submersible offshore unit, or within a hold of a vessel offshore unit.

With regard to specific aspects of the invention, the evacuation module bay includes a mechanism for flooding the submarine bay and for operating the door, a hook mechanism for coupling the submarine to the submarine bay and a control system for operating the flooding, the door operating and the hook mechanisms. The control system may include haudraulic, electrical and mechanical systems. The evacuation module bay may also include a roller system for cradling the submarine and guiding its movement into and out of the bay, and à sonar system for detecting obstructions near the bay door outside of the bay.

In accordance with another aspect of the invention, the evacuation module includes a dry entry tube, which may be made of flexible material, for connecting a universal mating system hatch on the submarine to a hatch on a wall of the submarine bay to provide a watertight passage from the submarine bay hatch to the universal mating system submarine hatch. The hatch may also include a switch for activating the control system.

In accordance with another aspect of this invention, the submarine includes a connector for coupling the submarine to the hook mechanism, wherein the connector includes a U-bolt, which may be sheared from within the submarine. In addition, the submarine may include a control system for directly operating the flooding and the door operating mechanisms.

Further, this invention is directed to a method of evacuating personnel from an offshore unit having a portion adapted to be submerged below the water level, wherein the offshore unit includes at least one submarine module having a submarine held within a watertight submarine bay; the method comprises having the personnel enter the submarine, flooding the bay, opening the door in the submarine bay and propelling the submarine from the bay to a predetermined location remote from the offshore unit.

In accordance with a further aspect of this invention, the first step of the evacuation method may include having the personnel gather at a muster station, counting the personnel gathered, checking the submarine and having the personnel enter the submarine.

In accordance with another aspect of this invention, the first step of the evacuation method may include having the personnel gather at a muster station on a deck of the offshore unit, counting the personnel gathered, having the personnel proceed to a muster station at the submarine bay, counting the personnel at the submarine bay muster station, checking the submarine and having the personnel enter the submarine.

Other aspects and advantages of the invention, as well as the structure and operation of various embodiments of the invention, will become apparent to those ordinarily skilled in the art upon review of the following description of the invention in conjunction with the accompanying drawings.

Brief Description of the Drawings

The invention will be described with reference to the accompanying drawings, wherein:

Figure 1 illustrates a schematic view of a semi-submersible drilling rig;

Figure 2 is a cross-section side view of an evacuation system module;

Figure 3 is a cross-section front view of the evacuation system module;

Figures 4a and 4b show the location of retrofit evacuation modules in accordance with the present invention over or in a pontoon of the drilling rig;

Figure 5 shows the location of newly constructed evacuation modules in accordance with the present invention within a pontoon of the drilling rig;

Figures 6a and 6b illustrate, in top view, the location of evacuation modules in

or on the pontoons of the drilling rig;

Figures 7a and 7b schematically illustrate the location of evacuation modules in accordance with the present invention within a vessel;

Figure 8 illustrates the Universal Mating System (UMS) for the evacuation module in figure 5;

Figures 9a, 9b and 9c illustrate in front view, side view and top view a sliding door arrangement for the evacuation module in figure 5;

Figures 10a and 10b illustrate the seal between the tube door and the vessel hull for the evacuation module in figure 7;

Figure 11a and 11b illustrate the submarine hold-fast hook for the evacuation module in figure 5;

Figure 12 illustrates the submarine U-bolt for the evacuation module in figure 5;

Figures 13a, 13b and 13c illustrate the roller system for the evacuation module in figures 5 and 6;

Figure 14 illustrates apparatus for manually releasing the submarine U-bolt;

Figure 15 illustrates the a hydraulic system for the evacuation module in figure 5; and

Figures 16a and 16b illustrate the evacuation process using an evacuation module in accordance with the present invention.

Detailed Description of the Invention

A submarine evacuation system in accordance with the present invention will be described in conjunction with semi-submersible drilling rig 1 of the type shown in figure 1. However, it will become clear that the invention can also be used with any type of structure or vessel that operates in large bodies of water such as lakes or oceans; these include platform and jack up rigs, drilling ships as well as other ships. Personnel normally work and live on these offshore units for predetermined periods of time, but must be evacuated from time to time due to extreme emergency conditions such as violent weather. The present submarine evacuation system comprises one or more underwater modules that are attached to or built into the offshore unit such that they are not adversely affected by the water surface conditions. Each module includes a submarine that is launched with a contingent of personnel from the offshore unit. The submarine would also be launched during maintenance checks and drills. Though the prime purpose of the submarine evacuation system is to evacuate personnel in emergency situations, the submarines may also be used to ferry

personnel and cargo to and from the offshore units.

The semi-submersible drilling rig 1, illustrated in figure 1, includes a pair of pontoons 11 with a number of vertical columns or pillars 12 that support an upper hull 13. Some of the columns 12 may be partially hollow to allow passage from the upper hull 13 to the pontoons 11. The hull 13 includes the accommodation area 14 with a helideck as well as the drilling floor, equipment and tower 15. The rigidity of the structure is achieved by transverse braces 16 between the columns 12 and other braces 17 between the columns 12 and the hull 13. The pontoons 11 include ballast tanks 18 that are flooded with water to submerge the drilling rig 1 to a predetermined depth for stability. The rig 1 may have its own propulsion system 19 for moving it from one location to another, however the rig 1 would normally be towed by tugs if it were to be moved any great distance. While in position for drilling, the rig 1 could be held in place by anchors or could be dynamically positioned through the use of thrusters.

The submarine evacuation module 20 in accordance with the present invention, as seen in figures 2 and 3, comprises an enclosed bay 22 in the shape of a large tube for receiving a submarine type of self propelled underwater vehicle 21; the bay 22 is mounted within or on an offshore unit as will be described below. The submarine 21is cradled within the bay 22 by a roller system 23 comprising five sets of rollers 231 to 235 positioned longitudinally along the bay. Three sets of rollers 231 to 233 support the bottom and the lower sides of the submarine 21 while the remaining sets of rollers 234 and 235 are positioned to contact the submarine 22 on its upper sides. In addition, the submarine evacuation system 20 includes a hold fast hook 24, which couples to a u-bolt 26 to hold the submarine 21 in place. The bay 22 further includes a hydraulic control system 27, which is used to control the flooding of the bay 22 via the sea chest valve 28, to control the opening of the bay door 29 via a valve 295 and the deflooding of the bay via the sump 30. Further, the module 20 includes a vent 33 to surface whereby air displaced by water entering the tube 22 through the sea chest 28 can escape to allow the tube 22 to be fully flooded. In addition, pipes 34 are connected to the pontoons' ballast system such that it may be used to de-flood the tube 22, if required, once the submarine has left the module 20 and the door 29 is closed. At the top of the submarine is located universal mating system (UMS) hatch 25, which connects to a dry entry tube 31, which extends between the submarine 21 and the inner wall of the module 20, to permit entry into the submarine 21. Details of these bay 22 components will be described below.

As described above, in operation, the pontoons 11 and a portion of the columns 12 of a semi-submersible rig 1 are normally submerged in the water. The submarine evacuation module 20 is therefore positioned below the water line, as shown in figures 4a and 4b, for a retro refit. In figure 4a, the submarine evacuation module 20 is positioned just above the pontoon 11 beside a column 12 allowing access to the submarine evacuation module 20 via a watertight utility shaft 40 and a dry entry tube 32 between shaft 40 and module 20. The utility shaft 40 can include a stairwell 41 as well as a pair of evacuation poles 42 leading from the upper deck 131 of the upper hull 13 as well as from the lower deck 132. In addition or alternately, the evacuation system in the utility shaft 40 to the tube 32 may include evacuation chutes. These may be of the type manufactured by DBC Marine Safety Systems Ltd. (www.dbcmarine.com). With the submarine evacuation modules 20 positioned above the pontoon 11, the modules 20 are above the surface of the ocean when the semi-submersible is being maoved. In such an arrangement, the modules 20 may be provided with a surface launch capability, permitting the submarine 21 to be launched onto the surface of the ocean.

In figure 4b, the submarine evacuation modules 20 are positioned in the ends of the pontoons 11, which would keep the modules 20 below the surface of the ocean even when moving the semi-submersible 1. Access to the modules 20 would be provided via the watertight utility shaft 40, a corridor 43 and tube 32.

In a further embodiment of a retro fit system, the submarine evacuation module may be located well above the water level such as on lower deck 132. In such an embodiment, a chute would be provided to enable the submarine 21 to enter the water. During drills and the like, the submarine 21 would have to be lifted back into position using a crane.

As shown in figure 5, for a newly constructed semi-submersible rig 1, submarine evacuation modules 20 may occupy the space normally used for ballast tanks and the utility shafts 40 descend to the top of the pontoon 11. In this embodiment, the space around the tube bay 22 can still be used for ballast, as can the space within the tube bay 22 after the submarine 21 has departed.

Figures 6a and 6b are top views of the pontoons 11 showing possible locations

for the submarine evacuation modules 20 either over or within the pontoons 11. In the embodiment where the submarine evacuation modules 20 are within the pontoons 11, the bay doors 29 are positioned against the hull of the pontoon 11. In the embodiment illustrated in figure 6a, the module includes a bay door 29 at one end of the module 20, whereas in the embodiment illustrated in figure 6b, the module includes a bay door 29 at both ends of the module 20 so that the submarine 21 can exit from either end of the module 20. This arrangement would be particularly advantageous if the rig 1 is listing to one side or the other since it would ensure a wet ejection of the submarine 21.

In the above embodiments described with respect to figures 5a, 5b, 6a and 6b, the submarine evacuation systems 20 are shown to be positioned next to the columns 12, and utility shafts 40 are provided for the personnel to descend to the submarine module 20; however, the columns 12, which are normally hollow, can alternately be used to provide access form the upper and lower decks 131, 132 to the upper surface of the pontoon 11.

As shown in the schematic drawings in figures 7a and 7b, the submarine evacuation modules 20 may also be mounted within a vessel such as a drilling ship 70 or other vessel, either below or above the water line. Typically a ship 70 is divided into watertight compartments 71 by bulkheads 72. A submarine evacuation module 20 may be located in one or more of the compartments 71 on both sides of the vessel 70. Alternately, as illustrated in figure 7b, the bulkhead between the modules 20 mounted end to end may be eliminated forming a long module 20a, in which two submarines are located end to end. With doors port and starboard, the two submarines 21 would be permitted to exit the module 20a from one end or the other of the module 20a. Again, this would be particularly advantageous if the ship is listing as it allow for a wet ejection. However, the submarines 21 could also exit from opposite ends as if they were in their own modules 20.

The submarine bay 22 may be of any appropriate shape to receive the submarine 21. As shown in figures 2 and 3, for an elongated generally cylindrically shaped submarine 21, the bay 22 would have a tubular shaped body 221 that is closed off at one end by a wall 222 and other the other end by the bay door system 29. The tubular body 221 may be circular, oblong, square or rectangular in cross-section. Marinel, an ultra high strength cupronickel alloy, K0500 is an appropriate material for

the construction of the bay 22. Tubes, suitable for this purpose, are manufactured by Metals Unlimited (www.metalsunlimited.com).

The submarine 21, such as an Odyssey manufactured by ISE Ltd. (www.ise.bc.ca), is fitted with seating 210 to carry personnel from the rig 1. As with all submarines, the submarine 21 includes a ballast tank 211 and ballast tank valves 212 to control its ascent and descent in the water. It also includes air tanks 213 and vents 214. The submarine propulsion system includes an electric motor 215 driven by batteries housed in a seamless, stainless steel battery storage area 216 and a diesel motor (not shown). The diesel motor is used to drive the submarine as well as to recharge the batteries, and may be operated while the submarine 21 is on the surface of the water or submerged. The submarine 21 includes a UMS hatch 25 for entry into the submarine 21 and may further include an override control center 217 located in the coxswain compartment in the front of the submarine 21 for controlling the evacuation sequence, if required. The submarine 21 would normally also have its own sonar system 296 for underwater navigation.

Though it is desirable to have the bay 22 totally empty of water while the submarine 21 is in the bay 22 and not in use, it may occur that it is necessary to have the bay 22 flooded, and therefore in order to be able to load the submarine 21, a dry entry tube 31 is necessary. The tube 31 is positioned between the hatch 221 on the bay 22 and the UMS hatch 25 to allow the movement of personnel from above the module 20 wall into the submarine 21. The tube 31 is permanently sealed to the hatch 221 by a compressible pipe connector 222 at the bay 22 and is detachably sealed to the UMS hatch 25 at the submarine 21 by an expandable pipe connector 250, which presses up against the cowling 251 on the UMS hatch 25. The expandable pipe connector 250 is designed to release after the hatch 25 has been closed and sealed. The bay hatch 221 prevents water from entering into the space above the bay 22 from within the tube 31 when it is detached from the submarine 21. The tube 31 may be made of any type of material that will allow it to withstand the pressure of the surrounding water, however it is preferred to be made out of a flexible material such as rubber or Teflon®. In addition, an activation button 313 is located within the UMS hatch 25, which starts the launch sequence once the last person has entered the submarine 21. The activation button 313 is located in the dogged seal of the hatch 25 such that it is activated when the hatch 25 is closed.

A similar flexible tube 32 with compressible pipe connectors may be used to permanently seal a tunnel between the bay 22 hatch 221 and the utility shaft 40 as shown on figure 5, to keep the ballast water in the pontoon 11 from entering the utility shaft 40 or the bay 22.

A watertight door system 29 of the type illustrated in figures 9a to 9c is used to isolate the submarine bay 22 from the water outside of the offshore unit 1. Though this door system 29 is shown as being of the sliding door type, a swinging door type of system could also be used. The door system 29 may be of the Jefferson type manufactured by USA Sliding Doors, Inc. (www.usaslidingdoors.com). The watertight door system 29 includes a door 290 that slides within a frame 291. The system 29 is installed as a unit by welding the frame to the hull 299 of the pontoon 11 or other vessel. Hydraulic cylinders 292, under pressure hold the door closed within the frame 291. In addition, springs 294 are positioned within the frame 291, under compression, to push against the door 290 to open it as the pressure in the cylinders 292 is released. It is preferred that the sliding door system 29 be made of the same material as the offshore unit hull 299, as this will prevent the generation of electrical currents between dissimilar metals in salt water. For example, if the offshore unit hull 299 is manufactured from H 30 Steel, then the door system 29 will be made from the same grade of steel. A sonar system 296 transmitting and receiving unit would also be attached to the hull 299 just outside of the door system 29 in order to detect any obstructions that could prevent the submarine 21 from leaving the submarine bay 22.

To assure that the bay 22 is watertight, a seal 294 is placed along the outer edge of the bay 22 wall and the inner wall of the hull 299 as illustrated in figures 10a and 10b. These same seals 294 will also make the door watertight.

The release hook system 24 that is used to prevent forward and aft motion of the submarine 21 while it is cradled in the bay 22 may be a Z series quick release hook manufactured by Zlada Technology (www.zaldatechnology.com) as shown in side view in figure 11a and in top view in figure 11b. Hook system 24 includes a base 240 which may be bolted or preferably welded to the bay 22 wall. The frame 241 of the hook system 24 is pivotally mounted to the base 240 to permit it to move in a horizontal plane. A hook 242 is latched within the frame 241 such that it is held in a closed position. A manual release/safety lock can be actuated by arm 243 to release the hook 242. In addition, the hook 24 may be actuated remotely by electric,

pneumatic or hydraulic controls. The hook 24 may also monitor the load on the hook 242 for display.

As illustrated in figure 12, the submarine 21 is firmly coupled to the hook system 24 by a u-bolt 26. u-bolt 26 is fixed to the submarine 21 such that, as the submarine 21 backs into the bay 22, the u-bolt 26 passes over the hook 242, which is forced upward to latch onto the u-bolt 26 resulting in a snug fit which prevents the submarine 21 from moving forward or aft. For strength and durability, the u-bolt 26 may be a grade 8, 1541 stretch proof stainless steel finished with mechanical galvanizing. Aft in the submarine 21 is a watertight compartment 261as illustrated in figure 14. The compartment 261, which is sealed by a watertight hatch 262 houses the u-bolt 26 that holds the submarine 21 to the hook mechanism 24. Further a hydraulic jack 263 is located in the compartment 262. The jack 263 can be used to quickly shear off the ends 260 of the u-bolt 26 in case the hook mechanism 26 does not operate properly.

Each of the roller systems 231 to 235 consists of a series of three-foot chain roller sections; a roller section 232 is shown in a front view in figure 13a, in a side view in figure 13b and in a top view in figure 13c. Each section 236 is welded to a steel channel 237, which is welded to the interior of the bay 22 at locations shown in figures 2 and 3 resulting in a five contact points on the outside of the submarine 21. Each roller system 231 to 235 includes three-foot roller sections 236 placed end to end as close as possible. The roller system 231 to 235 cradles the submarine 21 and acts as a guide for the launch and the re-entry of the submarine 21. It also prevents any lateral movement of the submarine 1 while in the sub bay 22. The roller sections 236 may be the ERF Series Chain Action Steel Roller System having a 120 Ton capacity, manufactured by Hilman Rollers (www.hilmanrollers.com).

Each submarine evacuation module 20 has its own control system 27 to operate the loading and launching of the submarine 21. As illustrated in figure 15, the control system 27 contains the components of the evacuation system that are operated by hydraulics and/or electrical wiring. The system 27 includes the rig hull sonar 296, , a hydraulic reservoir 271, a hydraulic pump 272 and a hydraulic controller 273, which includes a conventional one way valve, hydraulic accumulator and pressure transmitter for each of the components. Appropriate hydraulic units are manufactured by Prohold Workholding, Inc. (www.prohold.com). The control system 27 further

includes a hydraulic and electrical control box 270, and an activation button 313, automatically controls the sea chest bay flooding valve 28, the door opening valve 295 and the hook 242 release valve 245. With the activation of the sea chest bay flooding valve 28, which is a pressure-released valve, the bay 22 is flooded. After a predetermined time delay, when flooding is complete, there will be equal pressure on the inside and the outside of the door 29, which facilitates its operation. In addition, the control system 27 receives sonar information from the sonar system 296 to determine whether obstacles exist that would prevent the submarine 21 from being launched. However, the manual override control center 217, which is connected to the control box via an umbilical connection, can be used to override the automatic control system 27. As seen in figure 15, the manual override control center 217 includes a deactivate button 313a to stop the launch process at any phase if required. In addition, the manual override control center 217 can then control the flood valve 28 via line 28a, the hook 24 release valve 245 via line 245a and the door 29 valve 295 via line 295a through the control box 270.

However, in addition, a mechanical system may be provided such that, through mechanical linkages, the sequence of events for launching the submarine 21 may be carried out when all personnel are on board. The steps carried out by the mechanical linkage system would include:

Step 1 - Hatch 25 closed and locked when all personnel on board.
Step 2 - Dry entry tube 31 released when hatch 25 locked.
Step 3 - Sea chest 28 opened to flood the evacuation module 20 when tube 31 released.
Step 4 - Door 29 is opened once the module is flooded.
Step 5 - The hold fast hook 24 is released once the door is open.

Thus, the control system 27, the manual override control center 217 or the mechanical system in each module 20 are basically utilized to flood the submarine bay 22, open the bay door 29, release the hook 242 to allow the submarine 21 to motor out of the bay 22 to safety. This process is reversed for re-entry of the submarine 21 into the bay 22 where it is guided by the roller systems 231 to 235 into place, the submarine 21 is coupled to the hook 242, the bay door 29 is closed, the bay 22 is deflooded by the sump 30.

For the safe operation of the submarine evacuation modules 20, particularly at times of critical emergency when the personnel must leave the offshore unit 1, a trained Coxswain and Assistant Coxswain would be placed in charge of each submarine evacuation modules 20. The Coxswain is responsible for the piloting and operation of the submarine 21, while the Assistant is responsible for the personnel that are to be evacuated, for the launch sequence, and to take over from the Coxswain if he/she is unable to fulfill his/her duties.

The process for evacuating the personnel assigned to a particular submarine evacuation module 20 from an offshore unit 1, in an emergency, is illustrated in figures 16a and 16b. Though a specific process is described herein, it is evident that certain non-critical steps may be omitted or others inserted, depending on the circumstances of the evacuation. The process includes:

Step A - Under the orders of the offshore unit 1 Captain, a general evacuation alarm is sounded on the offshore unit 1.

Step B - The personnel retrieve their survival suits and proceed to their assigned first muster station 161, (see figures 4 and 5). The first muster station 161 would normally be located on the lower deck 132 near the utility shaft 40.

Step C - The Assistant Coxswain does a head count at the first muster station 161.

Step D - The personnel are directed to proceed down the utility shaft 40 to the second muster station 162. The second muster station 162 is located at the bottom of the utility shaft 40 at the UMS hatch 312 to the submarine bay 22.

Step E - The Coxswain does a second head count at the second muster station.

Step F - The Coxswain enters the submarine 21 to ensure that the submarine evacuation module 20 is in the ready mode, to do a precheck of all gauges, navigational equipment and fuel and to initiate engine and system start.

Step G - Final instructions from the Captain of the offshore unit 1 are given to evacuate the unit 1 immediately or to remain on board. Personnel will remain at the second muster 162 station until such an order is given. The Coxswain confirms receiving the order and confirms that all personnel are present or accounted for. If the order is to abort the evacuation, the personnel return to their work stations.

Step H - If the order is to evacuate the unit 1, the personnel proceed to enter the submarine 21 and take their seats.

Step I - The Coxswain does a final head count.

Step J - The Assistant Coxswain is the last to enter the submarine 21 through the the dry entry tube 31 and presses the activate button for initiating the submarine launch control system 27.

Step K - If the submarine launch control system is initiated, the Assistant Coxswain closes the hatch 25 and verifies that it is properly sealed. If the hatch is not properly sealed, the Coxswain presses the stop button 313a to stop the submarine launch control system 27 so that the hatch 25 may be opened and reclosed after the submarine launch control system 27 is reinitiated.

Step L - The bay 22 is flooded under the control of the submarine launch control system 27.

Step M- The bay door 29 is opened under the control of the submarine launch control system 27.

Step N - The submarine evacuation module sonar 296 attached to the hull 299 verifies that there is no obstruction at the entrance to the bay 22 that would prevent the submarine 21 from being launched.

Step O - The hook 242 is released to free the submarine 21.

Step P - The submarine 21 is motored out of the bay 22 into the open water where it can continue to a rendezvous point or to shore either under the water surface if conditions warrant or on the surface using its diesel engine.

In the situation where the submarine launch control system 27 should fail after it is activated in step J, the following steps are taken:

Step KK- The Assistant Coxswain closes the hatch 25 and verifies that it is properly sealed.

Step LL- The bay 22 is flooded under the control of the manual override control center 217.

Step MM- The bay door 29 is opened under the control of the manual override control center 217.

Step NN- The submarine evacuation module sonar 296 attached to the hull 299 verifies that there is no obstruction at the entrance to the bay 22 that would prevent the submarine 21 from being launched.

Step OO- The U-bolt 26 is sheared to free the submarine 21.

Step P - The submarine 21 is motored out of the bay 22 into the open water where it can continue to a rendezvous point or to shore either under the water surface if conditions warrant or on the surface using its diesel engine.

For this type of evacuation system, periodic maintenance, education and training must be implemented on a regular basis. Drills must be conducted on a continuous basis such as the ones that are in place for current evacuation procedures. It is also desirable to conduct these drills during rough weather in order to properly prepare all personnel.

The submarine evacuation system in accordance with the present invention provides underwater evacuation modules for launching submarine vehicles from any type of vessel or fixed structures in large bodies of water, such as oceans. The benefit of this system being that violent weather conditions existing above the water level can be avoided in the event of an emergency evacuation.

While the invention has been described according to what is presently considered to be the most practical and preferred embodiments, it must be understood that the invention is not limited to the disclosed embodiments. Those ordinarily skilled in the art will understand that various modifications and equivalent structures and functions may be made without departing from the spirit and scope of the invention as defined in the claims. Therefore, the invention as defined in the claims must be accorded the broadest possible interpretation so as to encompass all such modifications and equivalent structures and functions.